

**III B.Tech II Semester Supplementary Examinations,
November/December 2005
METROLOGY
(Mechanical Engineering)**

Time: 3 hours**Max Marks: 80**

**Answer any FIVE Questions
All Questions carry equal marks**

1. (a) Identify the type of the following fits and specify shaft based fit equivalent to each of them.
 - i. $H_6 - t_7$
 - ii. $H_8 - p_6$
 - iii. $H_{11} - g_{11}$(b) Determine and sketch the limits of tolerance and allowance for a 75mm shaft and hole pair designated $H_7 - s_8$. The basic size lies in the range of 50-80mm. The multipliers for grades 7 and 8 are 16 and 25 respectively. The fundamental deviation for 's' shaft is $(1T7 + 0.4D)$ microns. [6+10]
2. (a) Describe the features, advantages and limitations of
 - i. Digital micrometer
 - ii. Bench micrometer
 - iii. Telescopic gauge(b) Describe with sketch
 - i. Imperial standard yard
 - ii. International prototype meter [10+6]
3. Discuss various methods of taper measurement of plug and ring gauges. [16]
4. (a) Differentiate between :
 - i. Standard gauges and limit gauges
 - ii. Ring gauges and plug gauges(b) Design general type GO and NO-GO gauges for components having 35 H6/e7 fit. The basic size falls in the diameter range of 30-50mm. The fundamental deviation for 'e' shaft $= (-11 D^{0.41})$ microns. The multipliers for 6 and 7 grades are 10 and 16. Take wear allowance as 10% of gauge tolerance. Sketch the gauges with values. [6+10]
5. (a) Explicate the working principle of an Autocollimator.
(b) Explicate the use of interferometer in measuring flatness of surfaces. [8+8]
6. (a) Explicate the measurement of surface roughness by electronic means.

- (b) The heights of peaks and valleys of 20 successive points on a surface are 80, 60, 88, 66, 78, 62, 80, 62, 81, 63, 83, 62, 80, 60, 80, 60, 81, 59, 82, 62 microns respectively, measured over a length 20 mm, Determine CLA and RMS values of roughness surface. [8+8]
7. (a) Elucidate with a neat sketch the working principle of electrical comparators.
(b) What are the various machine tool tests common to most of machine tools. [8+8]
8. (a) Describe the following terms in screw threads:
i. major diameter
ii. minor diameter
iii. effective diameter
iv. pitch
- (b) Describe the measurement gear tooth thickness by gear tooth caliper. [8+8]

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1. (a) Explain terms: Tolerance and allowance. Enumerate the differences between them.
- (b) For each of the following shaft and hole pair, calculate shaft tolerance, hole tolerance and analyze whether the pair is
 - i. Clearance fit
 - ii. Transition fit
 - iii. Interference fit.

| | |
|--|----------------------------------|
| Pair 1: Hole:- $50^{+0.50}_{+0.00}$ mm | Shaft:- $50^{-0.02}_{+0.005}$ mm |
| Pair 2: Hole:- $50^{+0.25}_{+0.00}$ mm | Shaft:- $50^{+0.05}_{+0.005}$ mm |
| Pair 3: Hole:- $50^{+0.04}_{+0.00}$ mm | Shaft:- $50^{+0.07}_{+0.04}$ mm |

Sketch the three fits on the same zero line. [8+8]
2. (a) Explain the occurrence of cumulative and progressive errors in micrometers
- (b) Describe the working principle of dial indicator with gear and pinion mechanism. [8+8]
3. (a) Enumerate the limitations of sine bar.
- (b) The angle of wedge shaped block is being checked with 100mm Sine bar. With slip gauges of 25.857mm height at one end of Sine bar, the dial gauge readings at each end of the work piece vary by 0.06mm, the gauge block end being low. If the work piece is 30mm long what should be the next height of the gauge block tried ? Also calculate the angle of the work piece? [8+8]
4. (a) Explicate the classification of plain limit gauges.
- (b) Design general type GO and NO-GO gauges for components having 25 H8/f9 fit. The basic size falls in the diameter range of 18-30mm. The fundamental deviation for 'f' shaft= $(-5.5 D^{0.4})$ microns. The multipliers for 8 and 9 grades are 25 and 40. Take wear allowance as 10% of gauge tolerance. Sketch the gauges with values. [6+10]
5. (a) Explicate the working principle of an Autocollimator.
- (b) Explicate the use of interferometer in measuring flatness of surfaces. [8+8]
6. (a) What are the factors affecting surface roughness? What is the necessity for controlling the surface texture?
- (b) Explicate the details of construction, principle and operation of stylus. [8+8]

7. (a) Explain with a neat sketch the working of visual gauging tools.
(b) Enlist the instruments and equipment essential for performing alignment tests. [8+8]
8. (a) Describe an exclusive method for effective diameter measurement which shows variation in drunken thread.
(b) Explicate gear metrology of spur gears with reference to
i. Lead
ii. profile [8+8]

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1. (a) Explain the terms: Unilateral tolerance system, bilateral tolerance system. Clearly explain the differences between them
- (b) For each of the following shaft and hole pair, calculate shaft tolerance, hole tolerance and analyze whether the pair is
 - i. Clearance fit
 - ii. Transition fit
 - iii. Interference fit.

| | |
|--|----------------------------------|
| Pair 1: Hole:- $50^{+0.25}_{+0.00}$ mm | Shaft:- $50^{+0.05}_{+0.005}$ mm |
| Pair 2: Hole:- $30^{+0.05}_{+0.00}$ mm | Shaft:- $30^{-0.02}_{+0.05}$ mm |
| Pair 3: Hole:- $25^{+0.04}_{+0.00}$ mm | Shaft:- $25^{+0.06}_{+0.04}$ mm |

Sketch the three fits. [8+8]
2. (a) Select minimum number of slip gauges to build the dimensions
 - i. 24.095mm
 - ii. 58.975mm

from M87 set.

- (b) Describe the procedure for deriving end standards from line standards with suitable examples. [8+8]
- 3. Discuss various methods of taper measurement of plug and ring gauges. [16]
- 4. (a) Differentiate between limit plug gauge and ring gauge.
- (b) Design general type GO and NO-GO gauges for components having 75 H9/d10 fit. The basic size falls in the diameter range of 50-80mm. The fundamental deviation for 'd' shaft= $(-16 D^{0.41})$ microns. The multipliers for 9 and 10 grades are 40 and 63. Take wear allowance as 10% of gauge tolerance. Sketch the gauges with values. [6+10]
- 5. Explicate the uses of
 - (a) autocollimator
 - (b) straight edge
 - (c) surface plates [6+5+5]
- 6. (a) What are various orders of geometrical irregularities on surfaces ? How these are classified?

- (b) Describe with a neat sketch the construction , principle and operation of Tomlinson surface meter. [6+10]
7. (a) Enlist various types of mechanical comparators and optical comparators.
- (b) Describe the following alignment tests on a lathe for
- i. Level of installation
 - ii. Parallelism of tailstock sleeve to saddle movement. [8+8]
8. (a) Elucidate measurement method of thread angle by two ball method.
- (b) Explicate gear metrology of spur gears with reference to Tooth thickness by constant chord method. [8+8]

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1. (a) Identify the type of the following fits and specify shaft based fit equivalent to each of them.
 - i. $H_7 - c_8$
 - ii. $H_6 - J_5$
 - iii. $H_8 - p_7$
 - (b) Determine and sketch the limits of tolerance and allowance for a 85mm shaft and hole pair designated $H_8 - c_7$. The basic size lies in the range of 80-100mm. The multipliers for grades 7 and 8 are 16 and 25 respectively. The fundamental deviation for 'c' shaft is $(-95 - 0.8D)$ microns. [6+10]
 2. (a) Enumerate various types of outside micrometers and their uses.
 - (b) What are line standards? Explain with examples, the characteristics of line standards. [10+6]
 3. (a) Explicate the principle of sine bar for angular measurement
 - (b) Show the arrangement of angle gauges with neat sketches to measure
 - i. $10^\circ - 20'$ and
 - ii. 56.26° with minimum number of gauges from a set of

$[1^\circ, 3^\circ, 9^\circ, 27^\circ, 41^\circ]$
 $[1', 3', 9', 27']$ and
 $[3'', 6'', 18'', 38'']$
- [8+8]
4. (a) Enunciate with examples Taylor's principle of gauge design for "Go gauges".
- (b) Design and sketch the 'workshop gauge', 'inspection gauge' and general type of 'GO and NO GO' plug gauges for checking holes of $30_{-0.03}^{+0.25}$ mm. Assume wear allowance is 10% of gauge tolerance. [6+10]
5. Enunciate
 - (a) Flatness
 - (b) Straightness
 - (c) Optical flat
 - (d) Interferometers.

[4×4]

6. (a) What are the advantages and limitations of stylus probe?
(b) Describe with a neat sketch the working of profilometer. [6+10]
7. (a) Describe the working principle of electronic comparators.
(b) Explain the following alignment tests on lathe:
 i. Parallelism of tailstock sleeve taper socket to saddle movement.
 ii. True running of head stock center. [8+8]
8. (a) Elucidate the measurement of effective diameter by three wire method
(b) Explicate gear metrology of spur gears with reference to
 i. Back lash
 ii. Tooth thickness [8+8]

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